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ABSTRACT

The design of teacher education programs, including the preparation of teachers for working with information and communication technology (ICT), requires balancing of multiple considerations. Attention should be given to characteristics of students, requirements of education authorities and prospective employers, broader community aspirations, and local institutional imperatives, including university policies and resource constraints. The process of preparing for the re-accreditation of teacher preparation programs at the University of Southern Queensland (USQ) provided an opportunity for review of the provisions for teaching and learning about ICT in the light of a changing policy environment for education. This paper describes how the existing degree program incorporates learning about ICT and discusses some adjustments being proposed to ensure that the revised program may better meet the needs of graduating teachers in the new millennium. The first section discusses the policy environment for ICT in teacher education, including mandated standards. Existing provision of ICT in teacher education at USQ is described in the second section, including three program elements (i.e., the core curriculum, optional minor study, and integration of ICT into general studies in education) and program deficiencies. The third section addresses integrating ICT in a revised teacher education program, including modeling the integration of ICT and facility needs. Contains 12 references. (MES)

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Setting Course for the New Millennium: Planning for ICT in a New Bachelor Degree Program

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Abstract: The design of teacher education programs, including the preparation of teachers for working with Information and Communication Technology (ICT), requires careful balancing of multiple considerations. Due attention should be given to the characteristics of students, the requirements of education authorities and prospective employers, broader community aspirations and local institutional imperatives including university policies and resource constraints. The process of preparing for the re-accreditation of teacher preparation programs at the University of Southern Queensland (USQ) provided an opportunity for a review of the provisions for teaching and learning about ICTs in the light of a changing policy environment for education. This paper describes how the existing degree program at USQ incorporates learning about ICTs and discusses some adjustments being proposed to ensure that the revised degree program may better meet the needs of graduating teachers in the new millennium.

When studies of computing first appeared in teacher education courses they were rightly seen as visionary innovations directed towards a distant future in which computers would be readily accessible in typical classrooms. Although computers were seen as important elements of the future in which students would live and work, they were rare and expensive pieces of equipment. Hence, the emphasis was most often on computer literacy and learning about computers. Even when personal computers became more affordable and began to appear in classrooms there were few programs, educational or otherwise, available off the shelf. Inevitably the incorporation of computing into teacher education courses tended to take a technocentric approach which included programming in BASIC or some other language.

Since that time there have been very significant developments in information and communication technology (ICT), its accessibility in typical classrooms and its treatment within teacher education courses. The hardware and software available in classrooms has advanced far beyond the level where it was necessary for teachers to have knowledge of computer programming in order to make use of the computer. Sophisticated computer hardware and software is widely available in classrooms and in Queensland the Government is committed to connecting every classroom to the Internet by 2001 (Education Queensland 1998b). By now most teacher education courses include required courses in computing. Moreover, the emphasis in those courses has moved away from technical knowledge and aspects such as programming. Instead the focus is likely to be on developing fluency with common software tools such as word processors and on the evaluation, selection and integration of software for the classroom.

Now as we enter the new millennium there are multiple factors which should impel us to evaluate and consider appropriate changes to current teacher education course provisions in respect of ICTs. Access to information and communication technology is now a given in most circumstances in western societies. Community aspirations for education have broadened to include expectations that students should both acquire skills in the use of ICTs and should have their learning across a range of areas magnified by their power. Recent discussions of the "new basics" for Queensland Government schools have included the proposal that the preparation of a multimedia presentation and the construction of a page on the World Wide Web should form part of a series of benchmark tasks for eight year olds (Education Queensland 1999). At present such a performance would be beyond the experience of many teachers or teacher educators and it presents a challenge for teacher preparation and professional development.

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The Policy Environment for ICTs in Teacher Education

The preparation and employment of teachers is increasingly subject to advisory or mandated standards in relation to ICT. In the USA the ISTE/NCATE foundation standards (NCATE 1992) have led the way but additional requirements apply in some jurisdictions. In the UK the requirements for initial teacher training (DfEE 1998) include prescriptions for the capabilities teachers must demonstrate with ICTs. In Queensland, Education Queensland, which as the operator of the Government school system is the major employer of teachers, has adopted a set of minimum standards for Learning Technology to be achieved for all teachers by 2001 (Education Queensland 1998a). More recently the Australian Council for Computers in Education has begun work on a national document about teacher competencies in respect of learning technology (ACCE 1999).

Although technical skills in the use of ICTs remain an important component of the various standards prescribed for teachers, they are no longer seen as the sole addition that should be made to a teacher education program in order to prepare teachers for teaching with ICTs. The Education Queensland (1998a) minimum standards for learning technology are presented in four sections which deal with IT skills, curriculum applications including classroom planning and management, school planning (for IT) and student centered learning. The standards are as much about knowledge of curriculum and pedagogy as about technology reflecting a shift in emphasis away from IT as content with an orientation to future work skills and towards IT as a tool for teaching and learning.

To date, the formal ICT requirements for graduating teachers in Queensland are minimal and may remain so because the Education Queensland standards have been developed and interpreted in such a way that accreditation can be achieved only in the context of a specific school. However, there is a strong expectation that teacher education programs should prepare students to the point where they are immediately capable of demonstrating all but the most context specific competencies when they graduate. Other factors being equal, graduates with these capabilities will be advantaged in seeking employment as teachers.

Against this background it seems clear that any new or revised teacher education program to be offered in Queensland should include experiences which will prepare students for teaching effectively with information and communication technology. A first step in revising the approach to ICTs in a teacher education program should be to examine the provisions of the existing program to determine which aspects are effective and what might be improved.

Existing Provision for ICTs in Teacher Education at USQ

Students undertaking teacher preparation at the University of Southern Queensland (USQ) may be exposed to ICTs in one or more of three program elements.

The first of these elements is the "core curriculum" which was introduced some years ago at USQ as part of all undergraduate programs. For students in teacher education programs it comprises three key areas, namely, communication and scholarship, computing, and studies of Australia in relation to the Asian and Pacific region. For students in most other courses it also includes an introductory statistics subject. These areas were selected for inclusion in the belief that they would be fundamental to the work of future Australian professionals. The core curriculum is generally experienced by students in the form of four units of study each of which is equivalent to one-eighth of a standard student load for a year. Thus all undergraduate students study one unit in general computing which, for most students, concentrates on basic theory and common applications.

The second way in which education students at USQ may undertake course work relevant to ICTs is in an option (minor) study. The four year education degree comprises 32 credit points of which four points are taken in an option study selected by the student from a range of packages offered by different departments. Students may select from such areas as visual arts, music, sciences, mathematics, business and so on. A four credit point option in educational computing is offered within the Faculty of Education and includes such topics as desktop publishing and presentation, Logo, hypermedia creation and instructional software. Students may take an additional two credit points (above the normal degree program) to qualify for a specialization in educational computing. The additional units focus on the application of ICTs in the classroom with the intent of graduating students who have sufficient background to provide some leadership in the use of ICTs for teaching.

The third way in which students are exposed to ICTs is in the context of their general studies in education subjects where, over time, some instructors have begun to integrate the use of ICTs. Practices have included the use of applications such as word processors and presentation packages, demonstration and review of curriculum software, communication activities using email and optional or required activities involving creation of web sites. Although integration of ICTs is encouraged the adoption of new practices is scattered and does not form part of any coherent strategy to integrate ICTs into teaching within the Faculty.

Although each of these offerings confers some benefits for students, individually and as a package they exhibit some serious limitations and deficiencies.

Fewer than 30% of students undertake the option study in educational computing. Hence, most students experience no coherent course work component related to the integration of ICT into their teaching. Their only exposure to ICT is in the core subject. The program structure places the core subject in the first year to ensure that students have essential computing skills to support their university study.

The core unit is taught as a service unit by another faculty and makes only limited concessions to the specific requirements of education students. It does not significantly address the educational use of computers because it is done at a point in the program where students have little or no background in education and because it is taught by faculty with expertise in computing rather than education.

An increasing proportion of new university students is arriving with essential computing skills acquired in secondary education or prior employment. For them a core computing subject with a focus on introductory skills acquisition is probably unnecessary. For those who arrive without computing skills, the learning curve in the core subject is sometimes too steep and they might be better served by a more gradual approach with a clearer connection to their major areas of study. For both groups, the difficulties described above in making explicit connections to education may diminish the value of the subject as a preparation for future professional application of ICT.

The subjects which make up the option and specialization in educational computing were originally specified when the present degree program was accredited in 1992. Although they have been adjusted over time to reflect more recent developments in ICT such as the World Wide Web, they would benefit from significant revision to address emerging issues in the educational use of ICTs. They could also benefit from a clearer focus on topics relevant to the needs of future teachers who may be expected to accept a degree of responsibility for offering leadership in the use of ICTs within their schools.

Teachers who reflect on their practice recognize that there is a natural inclination to "teach as they were taught" and that to change teaching practice requires a conscious effort. Access to appropriate models of teaching is an important aspect of teacher preparation and teacher educators are one significant source of such modeling of practice. The importance of students being presented with appropriate modeling of computer use within their teacher preparation program has been noted elsewhere (Parker 1997; Zachariades & Roberts 1995) and at USQ there has been a noticeable increase in the use of computers within various subjects in the teacher preparation program. However, there is as yet no systematic approach to integration of ICTs.

Almost all of the computers available to students at USQ are installed in 20 seat laboratories that are timetabled on a fixed schedule for each week of a semester. This is unlike the model used in primary schools where computers are more likely to be found in groups of 3 to 6 in or near to a standard classroom. This arrangement restricts the opportunity for modeling the integration of computers into standard classes.

A second significant source of models of teaching behavior are the teachers with whom students work during practicum experiences. Some of these teachers are confident, competent and consistent users of ICTs in their classrooms but many are not. Students returning from practicum during 1999 remarked on the variability in integration of ICTs in the classrooms where they worked, reporting a full range from an unused computer at the back of a classroom to curriculum activities which used Internet resources as a focus. Because of the number of students who must be placed, there is little chance of the university being able to ensure that every student

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teacher is placed with a teacher who is making effective use of ICTs. Access by students to appropriate models of teaching with ICTs remains a challenge.

Integrating ICTs in a Revised Teacher Education Program

The most significant deficiency in the existing program is that most graduates have had little or no explicit preparation for integrating ICTs into their teaching. All should have at least basic skills in the use of common applications on personal computers. Those who have studied the educational computing option or specialization will have both substantially enhanced skills and preparation for using ICTs in teaching but they represent fewer than 30% of graduates. To address the expectations of employers, the revised bachelor degree program will need to ensure that all students are adequately prepared for teaching with ICTs.

USQ remains committed to the core curriculum requirement in undergraduate programs. However, some programs such as Engineering have negotiated the use of a specifically designed subject in place of the standard subject taken by students in most programs.

Historically the core subject in computing was introduced to enable students to develop computer literacy appropriate to the professions into which they would graduate. Since the subject was first introduced the understanding of computer literacy has developed and it is widely accepted that it may mean different things in different professional contexts. Now that the major employer of teachers in Queensland has identified a set of minimum standards for Learning Technology it is reasonable to argue that this statement constitutes a *de facto* definition of computer literacy for the teaching profession. Hence, if the USQ core curriculum is to remain true to its original intent, these standards should provide a foundation for determining which aspects of ICTs should contribute to the core curriculum for teacher education students. Examination of the Education Queensland standards reveals that more than two-thirds of the content is tightly bound to educational contexts. This should be reflected in the way that ICTs are incorporated into the teacher education program.

Skills that are taught in the existing core computing subject should not be neglected. They will be fundamental to success in both university study and professional practice in the new millennium. However, many students already enter with significant skills in computing. Hence, rather than mandate a full subject in basic skills for all students it may be preferable to monitor entry skills and offer short courses and mentoring for those whose skills are insufficiently developed.

To supplement this approach other subjects in the program should be reviewed and aspects that might be enhanced through the use of ICTs should be identified. Key skills could then be taught or reinforced in appropriate contexts. For example, word processing could be developed in association with communication and scholarship studies, spreadsheets might be used in mathematics and science methods, and computer graphics in the arts. Integration of learning about ICTs into contexts where their use is a natural adjunct to the work being done should increase students' motivation. Under the existing arrangements at USQ, skills in the use of ICTs are often taught in isolation from their application and students do not appreciate their relevance. By the time students encounter situations where the skills might be applied they have sometimes lost most of the fluency they had acquired. Learning skills closer to the context of real use should also encourage reinforcement of learning through additional opportunities for practice.

Integrating learning about ICTs across the teacher education program should increase the exposure of students to modeling of the integration of ICTs into teaching and learning. However, there will be challenges to be met. Although the staff who contribute to the teacher education program are mostly comfortable with the use of ICTs to support their own teaching and scholarship, many would not be comfortable with a requirement to integrate the use of ICTs into their classes or with teaching relevant ICT skills to students. Mentoring is one approach which has been found to be successful in assisting staff to develop both the competence and the confidence to integrate ICTs into a teacher education program (Stewart 1999). Because the integration of ICTs into teaching will necessitate some cultural change the process will require time but the level of acceptance of ICTs for personal use achieved over the past decade suggests that such change is possible.

Among the goals set in the *Schooling 2001* project for Queensland Government schools are the use of learning technology in every subject at every year level and the connection of every classroom to the Internet (Education Queensland 1998b). Both goals imply that ICTs in schools should not be restricted to isolated laboratories but should be distributed across classrooms. Schools are progressively extending network connections to classrooms and creating mini-labs of 3 to 6 computers in classrooms or adjacent spaces.

In order to model these learning environments within the teacher education program it will be necessary to provide equivalent facilities. In some (secure) teaching spaces it will be appropriate to create a mini-lab. Teaching in other spaces that are less easily secured may be served through the use of sets of laptop computers and mobile multimedia systems. An application for a special grant to initiate these developments has been made to the University and additional budget options are being considered.

There are multiple reasons why the present core computing subject in the teacher education program is unable to appropriately address educational aspects of computing. The first is that the subject is taught by members of the Department of Mathematics and Computing in the Faculty of Science. Their expertise lies in computing as a discipline and not in education or the educational application of ICTs. A second reason is that students study the subject in the first year of their program because that maximizes their opportunity to utilize the skills during their university study. However, it precedes study of educational theory that would be required to support their appreciation of issues in educational use of ICTs.

If it were possible to excise the core computing subject from the program by some combination of substitution of short courses and integration of basic ICT skills in other subjects, then it would be possible to replace it with a unit taken later in the program. That new subject could address the ICT competencies identified in employer requirements and other key policy documents.

Because of the importance of appropriate modeling of behavior in the process of learning to teach, a subject dealing with the educational use of ICTs should include opportunities for students to observe and participate in the application of ICTs for teaching and learning in classrooms. Ideally this might be achieved through appropriate practicum placements associated with the subject but the variability in teachers' use of ICTs makes it difficult to ensure that all students could be appropriately placed. A partial solution might be found through the use of relevant multimedia case materials to supplement field experiences. Multimedia materials for this purpose have been developed (Gibson & Albion 1999) and the underlying principles of their design have been described elsewhere (Albion & Gibson 1998a; Albion & Gibson 1998b).

It seems likely that for the foreseeable future ICTs will continue to evolve rapidly. The implications for education include a continuing need for educational professionals with specialized skills in the application of ICTs in education and a capacity to offer support to their peers. The existing option and specialization in educational computing at USQ is intended to graduate teachers with these capabilities. Some revision of the subjects will be required to ensure that they adequately address current issues in the educational application of ICTs and that they articulate with other elements of the teacher education program. Because some of the introductory material currently contained in these subjects will be incorporated in the general program there will be additional opportunities to address more advanced matters such as planning for and managing ICT resources in schools and providing colleagues with support and leadership in the application of ICTs.

Conclusion

There appears to be general acceptance that ICTs are important to education both as content and as aids to teaching and learning. Widespread availability of ICTs in schools and the wider community will surely result in students entering teacher education programs with increasing levels of skill. Nevertheless, the rate of development of new technologies and growing sophistication in their educational use makes it likely that, for the anticipated seven year life of the re-accredited program, there will be a continuing need for specific instruction about ICTs and their educational applications.

The program should provide students with early opportunities to develop any additional skills they may need for study at university. Every encouragement should be given to students to use ICTs wherever appropriate in their

studies and, so far as possible, the teaching and learning methods promoted in the program should model effective approaches to the integration of ICTs. Formal consideration of the educational application of ICTs should be deferred until students have encountered relevant educational theory. Students with a particular interest in ICTs should have opportunities to extend their study in related areas.

There are no certain answers in a rapidly developing field such as the educational use of ICTs. The approaches recommended here are based upon a reading of the policy environment in respect of ICTs in education, experience of the recent past, and consideration of current research. Only time will tell how successful they may be in charting a course for ICT in teacher education into the new millennium.

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